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ABSTRACT

This experimental study has three aims: (1) to give a detailed description of imitative behavior as it develops during the first six months of life; (2) to compare imitative responses perceived through visual, kinesthetic and auditory modalities; and (3) to describe and explain the regulating mechanisms and processes present in the early development of imitation. To accomplish these aims, 12 first-born female infants were tested in their homes every two weeks between the ages of 1 and 6 months. A total of eight visual, three kinesthetic and three auditory tests were administered. Thirteen behavior categories were observed during both the control and reaction periods. The two hypotheses formulated to guide the research are supported by the data presented in the three main sets of results. These results show that: (1) imitation exists as early as 1 month of age but is limited to certain types of models; (2) these first imitative responses wane between 2 and 3 months of age; and (3) there is absence of imitative response during the first 2 months of life to some other types of models, (i.e. auditory) but once imitation to these models comes in, it increases with age. (SDH)

THE ORIGIN AND DEVELOPMENT OF IMITATION IN THE FIRST SIX MONTHS OF LIFE[1]

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My talk will be divided in four parts, a short introduction about the state of knowledge in the study of imitation, the description of the experimental study on imitation, some of the assumptions and hypotheses that were made and finally some of the results that were obtained.

INTRODUCTION

The dabate in the literature on imitation started at the end of the nineteenth century with theoretical speculations that imitation is an instinct. Early during the twentieth century just as animal experiments were starting the first psychological theories about imitation emerged. Thus theories about imitation are to be found among psychoanalytic writings and also among writings by the gestaltists. These were theories within the framework of the particular schools concerned and were not based on any experimental or direct observations with humans.

In the early thirties naturalistic observations were conducted by psychologists on their own children with special interest in the origin and development of imitation during the first year of life. These studies include the works of Guillaume (1925), Piaget (1962) and Valentine (1930). Guillaume was the first to stand against the view that imitation is an instinct and together with Piaget offered developmental theories about imitation.

There followed a series of experimental observations with preschool, school-aged children and animals conducted mostly in America which lead to the description and explanation

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[1] Presented at the B.P.S. Annual Meeting; Liverpool, 5-9 April, 1973.

of imitation within the framework of learning theories. These studies together with some recent experimental observations on infants, i.e. Kaliski (1963), Paraskevopoulos and Hunt (1971) and Uzgiris (1972) are refined observations but do not consider imitation from a developmental point of view.

Piaget's study of imitation stands out both for the wealth of its observations and for its developmental theoretical underpinning. Piaget stressed the fact that imitation is a manifestation of the child's intelligence and demonstrated how closely related its development is to cognitive development during the sensori-motor period. He described the development of imitation in terms of success or failure, i.e. the infant's capacity at a certain age to reproduce a particular model and stressed the fact that the limits of each stage are set by the infant's cognitive capacity at the time.

Piaget carried out his study on hiw own three children his method was clinical rather than experimental. I believe that, for the further study of the development of imitation during early life, it is now important to employ experimental methods that will permit replication of the findings; at the same time any such method must be sensitive enough to take into account variations in the individual infant's capabilities within each stage of the development of imitation. The necessity for observing gradual changes in imitation as it develops requires also that the approach taken be longitudinal rather than cross-sectional. There are a number of concepts in the Piagetian approach that need refining and expanding. I hope that the present work will supplement his developmental theory.

This short review of the literature has served as an introduction to assess the current state of knowledge in the study of imitation and the theoretical orientation of the experimental study which I am now going to describe.

The aims of this experimental study were as follows:

a) to give a detailed description of imitative behaviour as it develops during the first six months of life;
b) to make a comparison of imitative responses to three groups of models, each perceived through a different sensory modality, namely visual, kinaesthetic and auditory;
c) to describe and explain the regulating mechanisms and processes present in the early development of imitation.

II METHOD AND PROCEDURE

A. SAMPLE. The sample consisted of 12 first-born normal female infants selected from the population available at St Mary's Hospital in London.

B. PROCEDURE. The infants were visited in their homes every two weeks from the time they were 1 month old until 6 months. The visits took place immediately after a feed. The infants were placed on a sofa in the supine position with a pillow under their head throughout the control period and the testing session. The mother was in the same room but out of the infant's sight. The experimenter's face was within the infant's visual field and the baby could look at her at will. Before the testing session each infant was observed for a control period of 12 min. during which the spontaneous activities were recorded and this provided baseline data with which the infants' reactions to the tests were compared. In fact during the control period there were twelve 30-secs intervals of observation time interspaced with twelve 30 secs note-taking time. The sessions lasted a little over half an hour; if the baby started fussing or crying at any time the session was suspended and resumed as soon as she was calm again.

C. THE TESTS. The tests form three groups that are described by the sensory modality through which they are perceived. There are the visual (V) tests, the kinaesthetic (K) tests and the auditory (A) tests. The order of administration varied by group of tests, thus 4 infants

were given the tests in the order VKA, 4 in the order AVK and 4 in the order KAV throughout the longitudinal study. Each test was administered three times with an interval of 30 secs between each administration.

Visual group of tests

This group included the following tests:

1. Four tongue protrusions without making any sound; this constitutes one administration of the tongue protrusion test.

2. Four tongue protrusions accompanied by the sound "m".

3. Side to side rhythmical movements of the head. This test was a replication of Piaget's test on his own children. The experimenter gets the infant to follow the movement of an object by moving it horizontally within the infant's visual field. In order to follow it the baby has to rotate her head from one side to the other at least three times. Once the head movement is obtained, the experimenter drops the object and starts moving her head the same way the baby was moving her own.

4. The same test is administered accompanied by the sound "aa". The order of tests with or without sound was counter-balanced over infants and over ages.

5. Opening and closing of the mouth without emitting any sound; the opening and closing is repeated four times and this constitutes one administration of the mouth movements test.

6. The experimenter moves her fingers for 10 secs while the baby is immobile.

From 4.5 months two additional tests are given in this visual group of tests.

7. Hands together; the experimenter moves both hands within the baby's visual field by bringing them together and moving them apart four times.

8. Scratching and banging; the baby is seated on the experimenter's lap. The experimenter scratches her dress and waits for 30 secs then bangs on her lap and waits for another 30 secs. The sequence is repeated three times.

Kinaesthetic group of tests

1. The experimenter gets hold of the baby's leg from the mid-calf and bends and straightens it several times rhythmically. As the test is given three times like all the others the two legs are alternated; i.e. first the left, then the right then the left one again.

2. The experimenter gets hold of the baby's arm from the elbow and moves it up and down parallel to the body rhythmically.

3. The experimenter gets hold of baby's both legs and bends and straightens them rhythmically with alternation of the movement several times - "bicyle-like" movement.

Auditory group of tests

1. When the baby is silent the experimenter while in face to face contact emits some vocal sounds selected from the spontaneous repertoire of infants under one year of age. They include single vowels and vowel groups, single consonants and consonant groups, vowel-consonant or consonant-vowel groups and finally some rhythmical sequences. Examples: a, o, oa etc., m, g, b, bvvv, pfff etc., bu, ma, ag etc. and "aa aa aa a", "ma-ma-ma-ma-ma"

2. The recording of a baby's babbling consisting mainly of sounds "m" and "a" was played on a tape recorder; the duration was 15 secs to make it comparable with the duration of the other tests. This was repeated three times with an interval of 30 secs between the playbacks. The age of the baby in the recording was 1.5 months.

3. The recording of a baby's high intensity crying was played on the tape recorder; the duration was 15 secs repeated three times with an interval of 30 secs between the playbacks. The age of the baby in the recording is 2 months.

During the administration of the recorded tests there was no visual contact between the baby and the experimenter.

The whole of the auditory group of tests was recorded on a second tape recorder; that is the models as well as the baby's vocal responses were recorded.

D. THE BEHAVIOUR CATEGORIES

It was essential to look for and note the same behaviour categories during the control period and across all tests for the following reason. To say that a response is imitative it is essential to show that it is similar to the model and it occurs in response to it. It is also essential to show that it occurs a) more frequently following the model than during the control period, and b) that it occurs in response to a particular model and not equally to every model.

So the behaviour categories that were observed and noted during both the control period and the reaction time to each test are the following:

- Arousal, i.e. uncoordinated limb and body movements
- Head movements, specifying if they are side-to-side movements, single or rhythmical, quick or slow
- Arm movements, specifying the direction of the movement and if one or both arms move
- Hand and finger movements
- Leg and feet movements, a single motion or rhythmical movements
- Scanning the environment
- Eye fixation, specifying the object of fixation
- Looking away
- Mouth and tongue movements, specifying if they are sucking movements in the void or related to an object and whether the object is part of the baby's body or an external one
- Tongue protrusion
- Smiling
- Whimpering
- Vocal sounds, specifying if they are single vowels or vowel groups, single consonants or consonant groups or vowel-consonant groups.

I am now going to talk about the main assumptions and hypotheses related to them before I pass on to the results.

III ASSUMPTIONS AND HYPOTHESES

Three assumptions were made: the first one has to do with imitation and the other two with the discriminative capacity of the young infant and her motor abilities.

A. In order to imitate a perceived model, a coordination is necessary between the perception of it and the motor reproduction of it. For example, in order to imitate tongue protrusion there has to be a coordination between the visual schema, to take up Piaget's terminology, and the infant's proprioceptive, kinaesthetic, tactile schema of tongue movement. This coordination may be an intersensory one as in the example of the tongue protrusion or intrasensory as in the case of the kinaesthetic models.

B. Work with infants in the laboratory has by now established the fact that very young infants have a very good discriminative capacity for perceived stimuli. Classic examples are Bower's (1966) and Carpenter's (1970, 1971 & 1972) studies on visual discrimination, Lipsitt's on olfactory (1963 & 1965) and gustatory (1972) discrimination and Eimas and Siqueland's (1971) studies on acoustic discrimination. The second assumption then is that the infant perceives and discriminates among the models administered to her and any difficulty she has in reproduction will be due either to the lack of coordination between the schemas involved or to an insufficiency connected with the motor ability to reproduce the model.

C, Finally, the third assumption is that during embryological development the foetus possesses and exercises some reflexes and movements. The earliest reflexes have to do with the head, the mouth and the tongue as in the case of sucking and rooting as has been shown by the work of Humphrey (1964 & 1971) The movements that a foetus makes are mainly body, leg and foot movements.

The reflexes available to the infant at birth form an organized totality. A good example is the rooting reflex where the head turns towards the source of stimulation and

the mouth opens at the same time, or the palmar-mental and Babkin reflexes when pressure on the palm causes chin lifting in one case and grasping with simultaneous opening of the mouth in the other. This totality gets dissociated with the disappearance of the reflexes and new differentiations and coordinations appear in the course of sensori-motor development, (Mounoud, 1971).

Hypotheses

A. The first hypothesis will carry this last assumption a little bit further. I think that in the first two months of life there is an organized totality not only of the reflexes available to the organism, but also of the infant with her environment. So one would expect certain particular inter- and intrasensory coordinations to exist during early postnatal life. If the dissociation-differentiation principle is true, one would expect these particular coordinations to disappear and the capacity for imitation to shift along with them.

B. The second hypothesis accordingly is that during the first 2 months of life there is going to be selective imitation. The preference and success of imitation will be dependent upon a) the embroyological experience of the infant which has to do with the reflexes the foetus possesses and the movements it makes, but also b) the movements that the infant exercises spontaneously during early postnatal life. So one would expect the privileged models to have to do with the head, the mouth and the legs.

On the other hand, models that can be reproduced by parts of the body that are not exercised during the embroyological development or immediately after birth will not be imitated. These are the auditory models and the ones that have to do with fine finger movements.

I must stress the fact that these are only two of the hypotheses that were made; there are others about the approximations between the model and its reproduction or the aspects and

features of the model that are first imitated or even others about the function of imitation during early life, but there is no time to discuss them here today.

IV THE RESULTS

There are three main sets of results that I am presenting here today. They show that:

a) as early as 1 month there is imitation, but it is limited to certain types of models;

b) there is a waning of these first imitative responses between 2 and 3 months of age; and

c) there is absence of imitative response during the first 2 months of life to some other types of models, but once imitation to these models comes in it increases with age.

What is called imitation depends of course on the operational definition one gives it, so for lack of such a definition that would fit all my models, I would rather at this stage of knowledge anyway, describe the infant's response to the tests rather than call it imitative and I shall do that as we go along with the slides. Let me just add that no order effects were found and the reliability study showed 92% agreement between two observers on the count of the presence and absence of the behaviour categories at the tests and during the control period.

Insert figures 1, 2 and 3 about here

The frequency of the occurence of the behaviours shown in all the graphs is given in percentages to make comparable the responses to the tests with the spontaneous occurence of similar behaviours during the control period, as the maximum possible differed in each case. In the case of the response to the tests, the maximum possible frequency of occurence at each age level is 36 (12 babies x 3 administrations of each item). In the case of the spontaneous behaviour during the control period the maximum possible frequency of occurence at each age level is 144 (12 babies x 12 time intervals during which the behaviour might have occured.)

Figure 1 shows the frequency at which the tongue protrusion response was given to the tongue protrusion model. The trend is quite clear and significant ($p < .05$). There is presence of the imitative behaviour at 1 month and then it decreases until it becomes sporadic from 2.5 months onwards. At 1 month all infants except one gave at least one imitative response to the tongue protrusion model. On the other hand, one infant kept imitating the model of tongue protrusion, but as I discovered later, she was reinforced by her father for sticking the tongue out as this became a privileged means of communication between them. It is to be noted that the presence of sound in the model seems to suppress the capacity for the reproduction of the movement. Imitation of tongue protrusion is observed again around the end of the first year of life as Piaget has reported and as it was in fact confirmed by the pilot study that preceded this work.

Figure 2 shows the frequency of mouth movements given as a response to the mouth movement model. This item was introduced rather late, hence the variable N at each age group. The general trend is the same as for the tongue protrusion. In the case of the tongue protrusion model exact reproduction was obtained whereas in the case of the mouth movements model, there was a combination of

approximations and deformations, that is to say sucking movements, pressing of the lips, licking etc. This may in fact account for the smoother slop. of the curve.

Figure 3 shows the frequency of mouth and tongue movements that occur spontaneously during the control period and the frequency of the spontaneous occurence of tongue protrusion. It is obvious that the trend of the imitative response follows closely the trend of the spontaneous occurence of mouth and tongue movements and in the case of the tongue protrusion the imitative response is obtained significantly more following the model than spontaneously.

Insert figure 4 about here

Figure 4 shows the frequency of the imitative response to the head movement model as well as the frequency of the spontaneous occurence of head movements. Here again if one compares the first 3 months to the second 3 months of life, the frequency of occurence of the imitative response diminishes, the trend reached significance ($p < .05$) between 3 and 4 months. The late introduction of the model with sound accounts for the absence of imitative response to this model at 1 month. It is worth noting that in this model sound seems to facilitate the imitation of the movement, so that the drop is delayed for the model with sound by half a month. What was called imitative response in this case was in fact a reduction which could be described as a quick slight horizontal movement of the head around the midline. The spontaneous rhythmical side to side movements of the head are of greater amplitude and slower than the movement obtained in imitation of the model.

From the kinaesthetic group of tests:

Insert figure 5 about here

Figure 5 shows the frequency of a) the correct reproduction of the model; this response involves only the correct leg at the exclusion of any other behaviour;

b) the response that was called reduction; i.e. correct leg exclusively but instead of the leg it is the foot that moves rhythmically up and down; and c) the frequency of the'correct localization' response; that is imitation and reduction put together. It is worth noting that a slight downward trend is obtained between 1 and 2.5 months, if one looks at the 'correct localization' curve only, an upward trend is obtained before six months whereas in the case of mouth and tongue movements this does not happen until much later.

All the above graphs show that indeed the imitation of the models involving the mouth, the tongue, the head and the leg is obtained more reliably during the first 2 months of life than say at 4 months. The developmental trends of imitative response reached significance for the tongue protrusion and the head movement models. In the case of the head movement the trend was obtained at a later age and one could argue that this happened because it was the only model that could be imitated by the direct continuation of the infant's accommodating movements.

Figures 6 to 12 will illustrate imitations that show different developmental trends.

Insert figures 6, 7 and 8 about here

For the finger movements model imitation is absent at 1 month and very rare at 1.5 months. Then we obtain three distinct types of response ; at 2 and 2.5 months the infant imitates the model only at its presence, that is moves her fingers while watching the experimenter's fingers move without looking at her own hands. At 3 months the imitative behaviour changes, that is the baby imitates the movement once the model has disappeared and watches her own fingers move. Lastly, from 5 months onwards the infant imitates the model once it has disappeared but again without looking at her own hands.

Figure 6 shows the frequency of the imitation of the finger movements model with or without looking at own hands.

Figure 7 shows the frequency of the spontaneous finger movements and the spontaneous looking at own hands which makes it appearance at 2.5 months.

Figure 8 shows the frequency of the imitative response to the finger movements model (with, plus without looking) and the frequency of the spontaneous finger movements, plus looking at own hands. Although spontaneous movements of the fingers occurred with roughly the same frequency throughout the age range examined imitative movements of the fingers increased from start to finish. The greatest increase happened about the time the babies were looking spontaneously more at their own fingers.

From the kinaesthetic group of tests:

Insert figure 9 about here

As for the leg, there are three types of response plotted in figure 9: correct reproduction of the movement; movement of the correct hand which is reduction; and 'correct localization' i.e. imitation, plus reduction. As for the imitation of the finger movements the frequency of occurence of the imitative response increases with age.

Finally the responses to the auditory group of tests show similar developmental trends as the imitative responses to the finger movements model and the arm movement model.

Insert figures 10, 11 and 12 about here

Figure 10 shows the frequency of the spontaneous occurence of vocalizations during the control period which increases with age; (the slight drop at 6 months is worth noting) and the frequency of the vocal responses of the

infants to the experimenter's sounds. It is obvious that the response to sound by sound that is plotted here follows the general trend of the spontaneous vocalizations, that is increases with age but there are more vocalizations when the baby hears a sound than when she does not. It is to be noted that the behaviour called vocal response is simply any vocal sound that the baby gave as a response to the experimenter's sounds. The analysis of the results to this test is not complete as it is extremely difficult and time consuming to analyse the sounds that the infants make.

Figure 11 shows the frequency of the reproduction of the recorded babbling model which increases with age and the frequency of the approximations which decrease with age. Approximations include any sound given by the infant during the intervals between the playbacks of the recordings. Reproduction is the vocal response obtained during the intervals containing the sounds "m" and "a" exclusively and repeated more than once as in the model.

Finally, figure 12 shows the frequency of the responses given to the recorded crying model. The first type of response obtained for this model is contagious crying, that is the baby starts crying upon hearing the model and does not stop unless she is picked up and comforted. This is the most common reaction up to 2.5 months and then disappears. From 2.5 months onwards the response called reproduction of the model starts to occur and its frequency increases with age. There are two conditions to be fulfilled for including the infant's response in this category: a) one is that the response was not a continuation of the response given to the previous recorded babbling model to which some babies give a whimpering response; and b) the second condition is that the response is given more than once during each interval. Lastly, the response called mimicry, i.e. crying face, follows closely the trend of the reproduction curve. This type of response is obtained either during the presence of the model, or immediately afterwards, or both, and it may or may not result in a vocal response.

On the whole the vocal responses to vocal sounds as well as the efforts to imitate the recorded models increase with age over the first six months of life and show the same developmental trends as the imitative behaviours of fine finger movements and arm movements.

CONCLUSION

In conclusion, we can say that the original assumptions and hypotheses have been supported by the data analysed so far. That is, certain inter- and intrasensory coordinations exist during the first 2 months of life. The capacity to imitate also exists and seems to be selective; it is dependent upon the embryological history of the infant and also the spontaneous exercise of schemas during the first 3 months of prenatal life. It is thus that only models involving the head, the mouth and the tongue are imitated during that period. The disappearence of the imitative capacity of these models may be due to the dissociation/ differentiation principle.

From 2 months onwards auditory models and the ones that have to do with the arm and fine finger movements are imitated and the imitative response increases with age.

The question still remains: why does the infant imitate? This, I should emphasize, was a study of non-reinforced imitation.

It seems to me there are two explanations; there may be others but I would rather mention the ones I believe are the more likely ones.

The first one is inspired by Piaget's theory. He has stated that the function of imitation is accommodation. If one accepts his 'equilibration process', (in other words that intelligence is adaptation and tends towards an equilibrium between the organism and the environment), then one could argue that the administration of the model to an

organism disrupts any state of equilibrium the organism may be in and the imitative response is among the acts that tend to restore equilibrium.

The second explanation could be that imitation has a biological-social function, that is communication between two organisms. If imitation serves as a means of communication between the infant and the human beings in his environment, then it is natural that it occurs often before the appearence of smiling on the one hand and of language on the other.

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LIST OF FIGURES

TONGUE PROTRUSION MODEL (N=36)

o——o Imitation of the movement; silent model

□——□ Imitation of the movement; model with sound

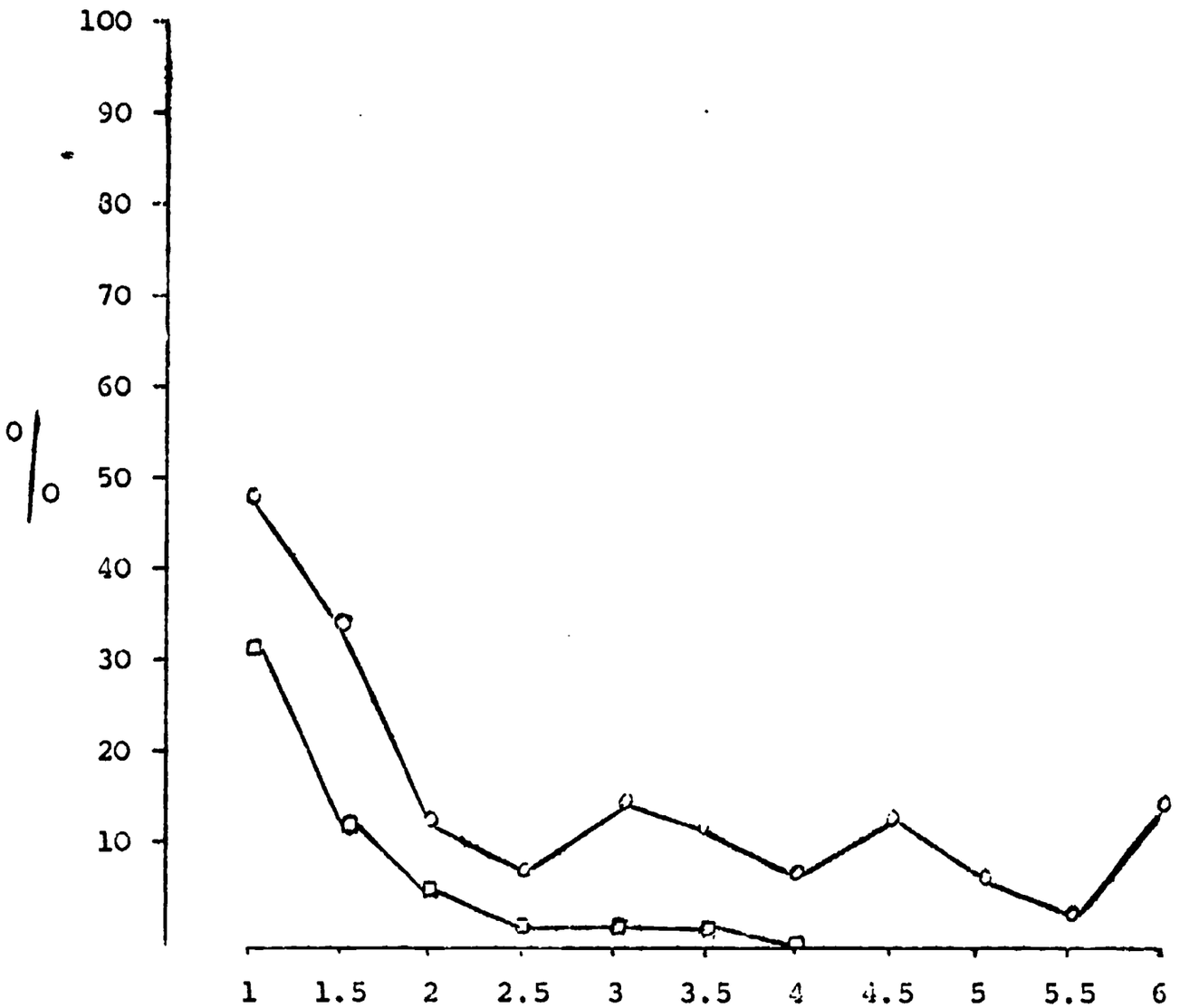

Figure 1

MOUTH MOVEMENT MODEL (N varies with age)

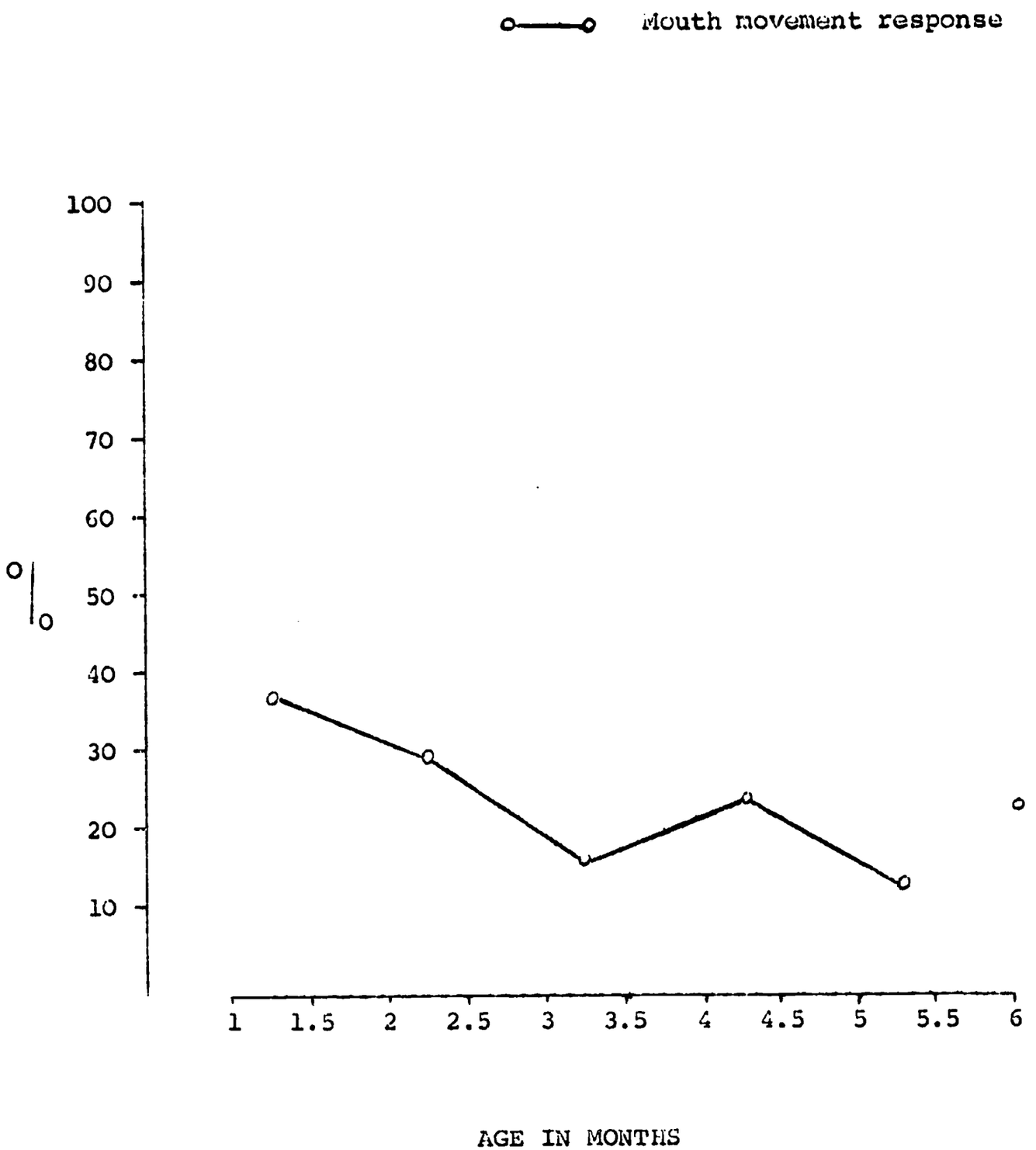

Figure 2

SPONTANEOUS MOUTH AND TONGUE MOVEMENTS (N=144)

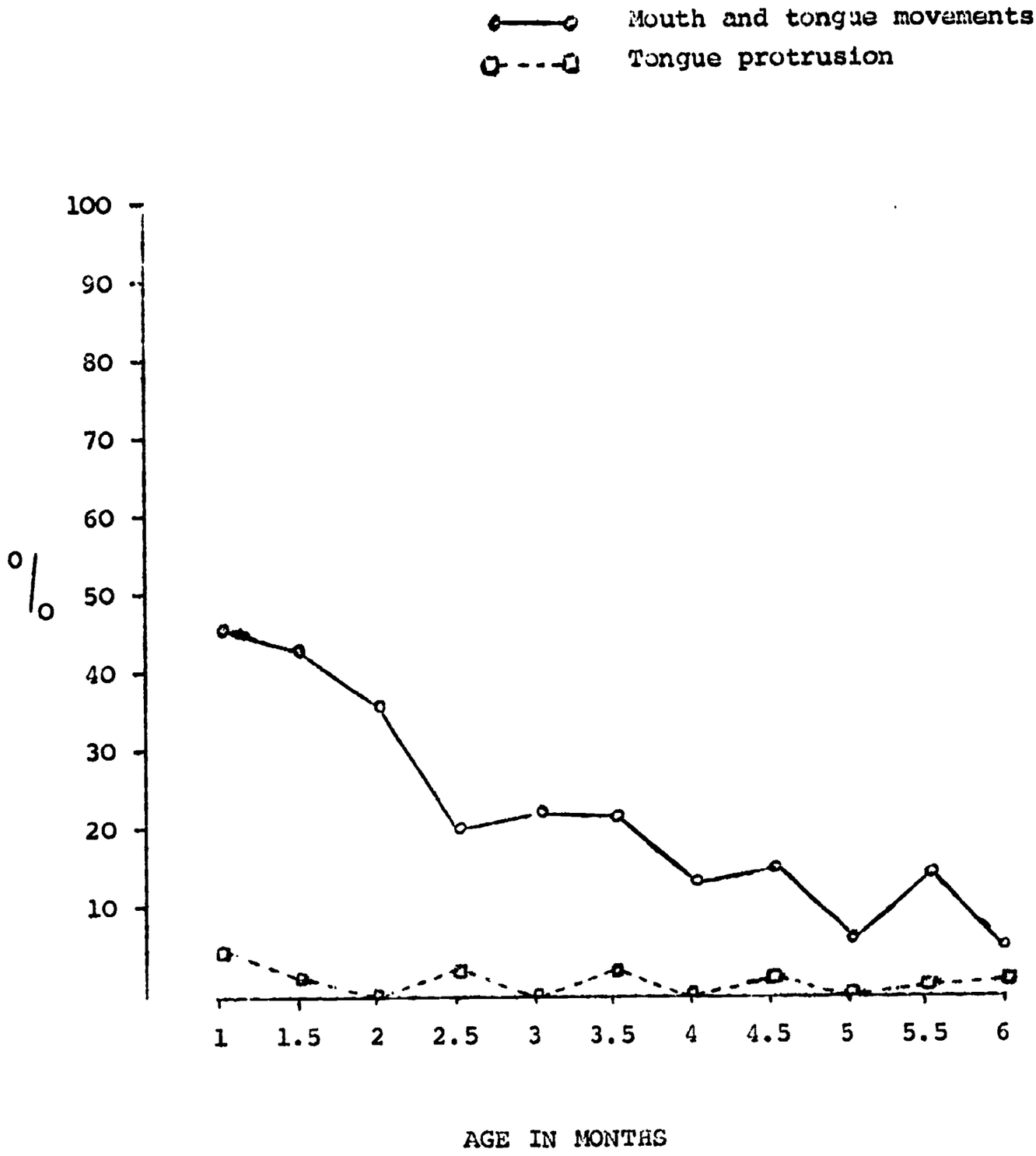

Figure 3

HEAD MOVEMENTS

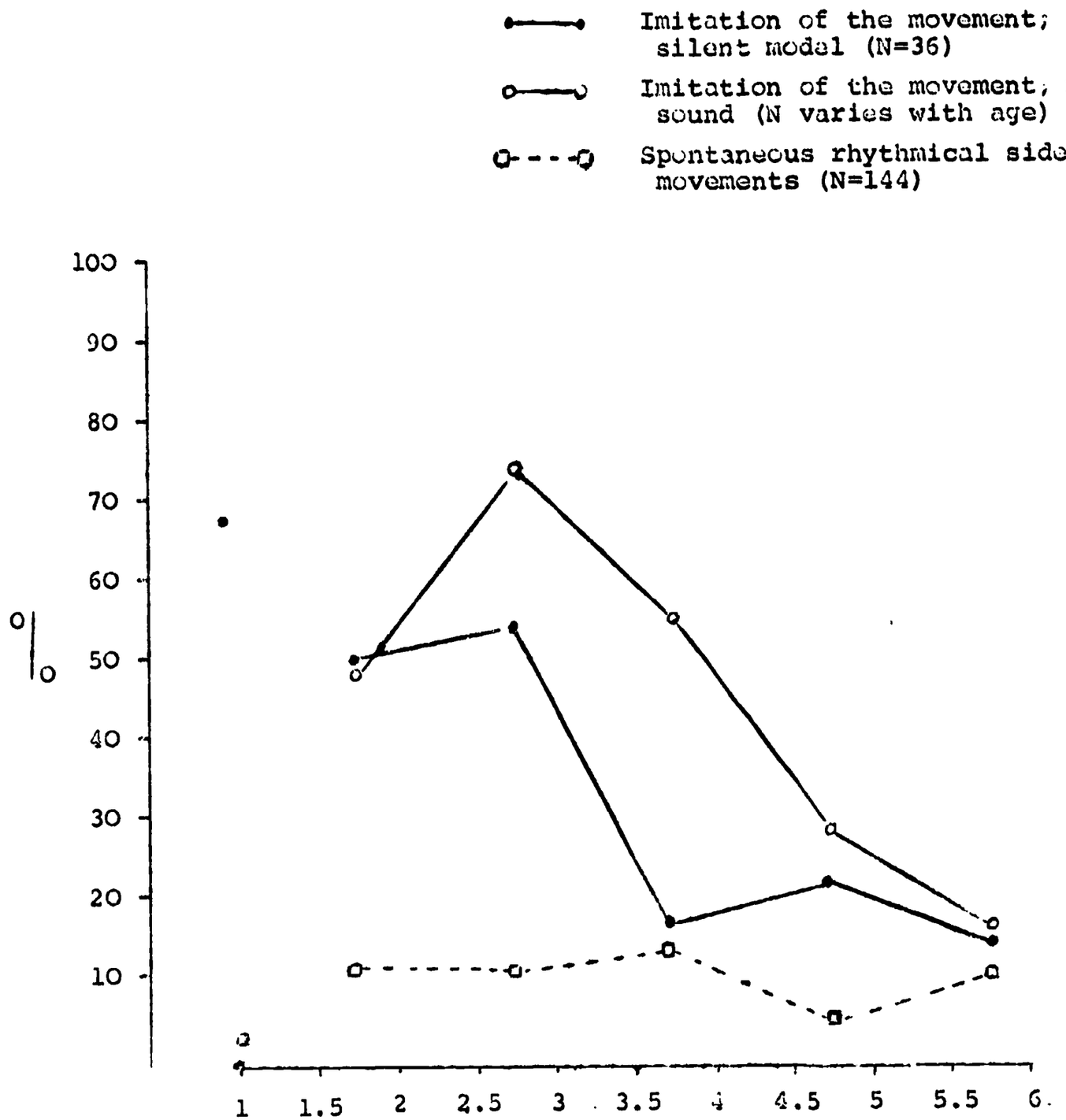

Figure 4

ONE LEG MOVEMENT MODEL (N=36)

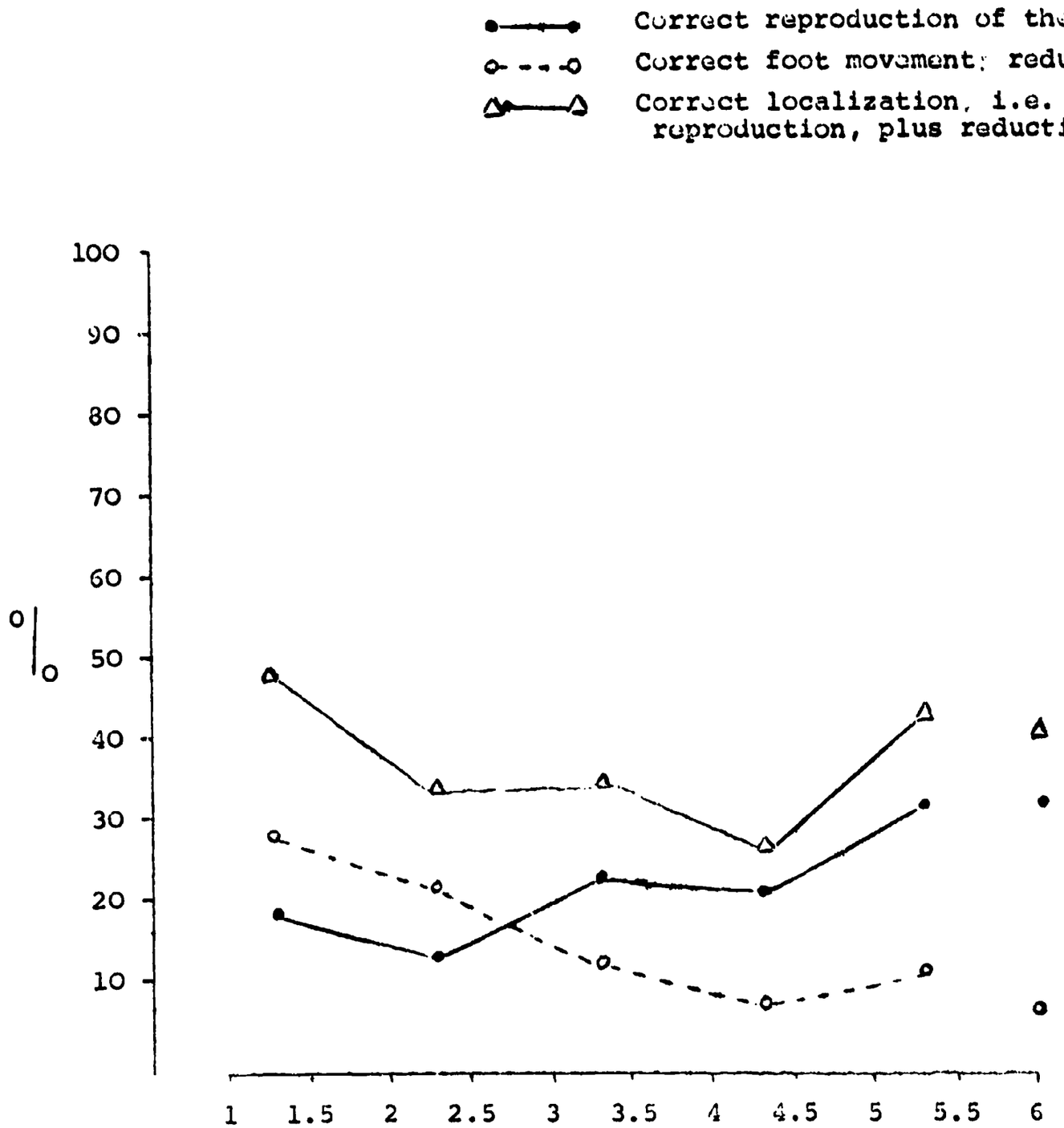

Figure 5

FINGER MOVEMENTS MODEL (N=36)

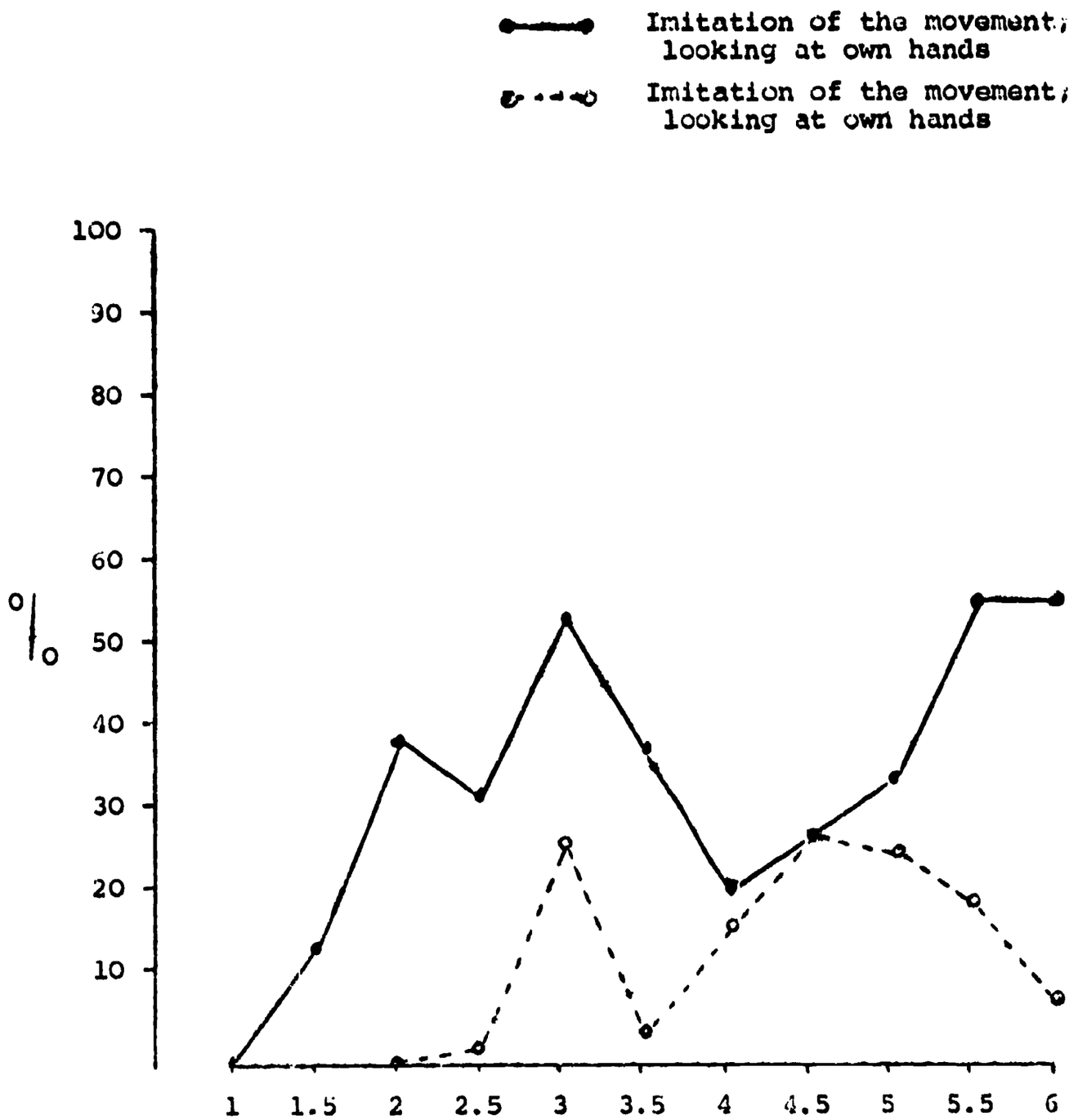

Figure 6

SPONTANEOUS FINGER MOVEMENTS (N=144)

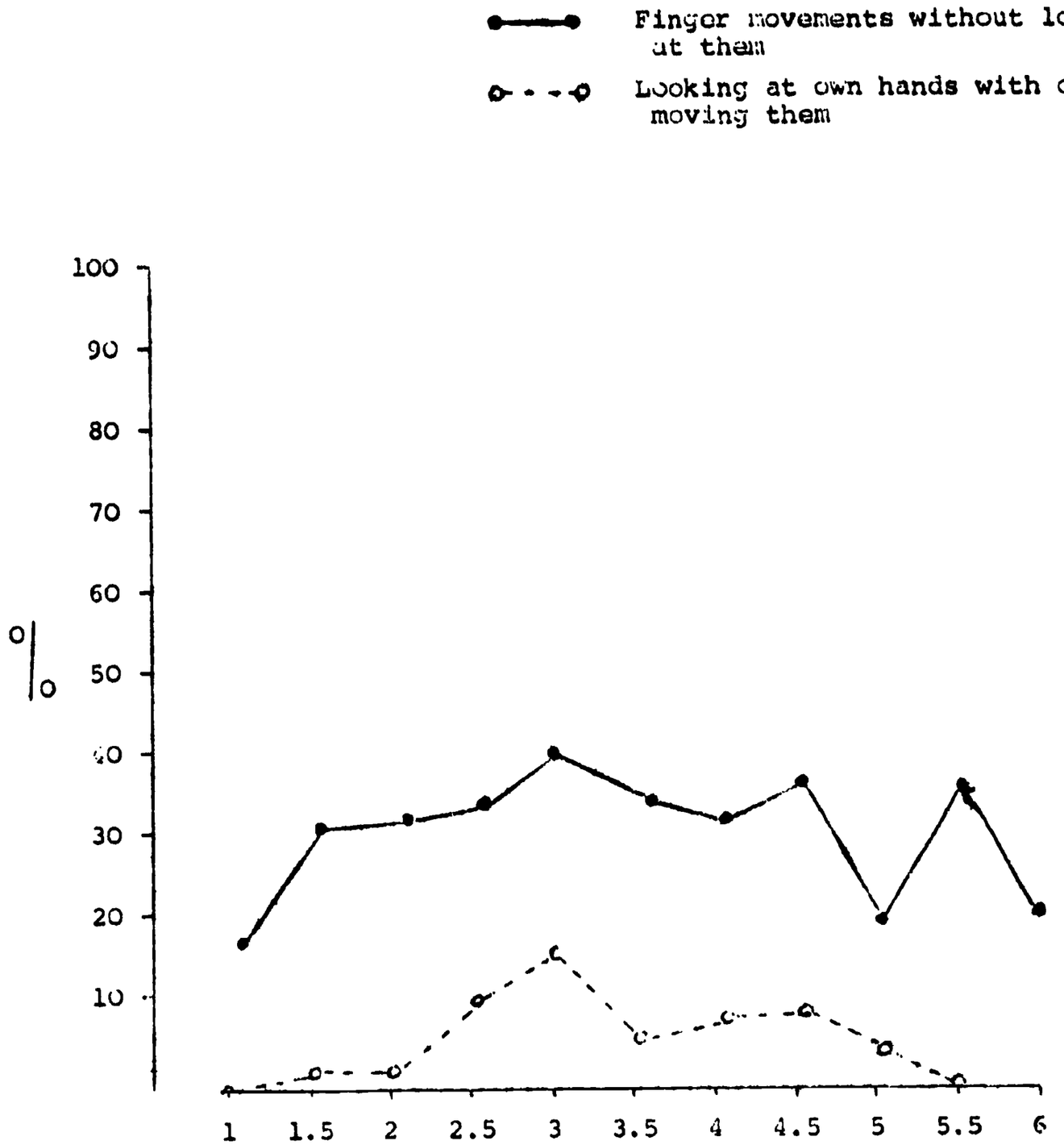

Figure 7

FINGER MOVEMENTS

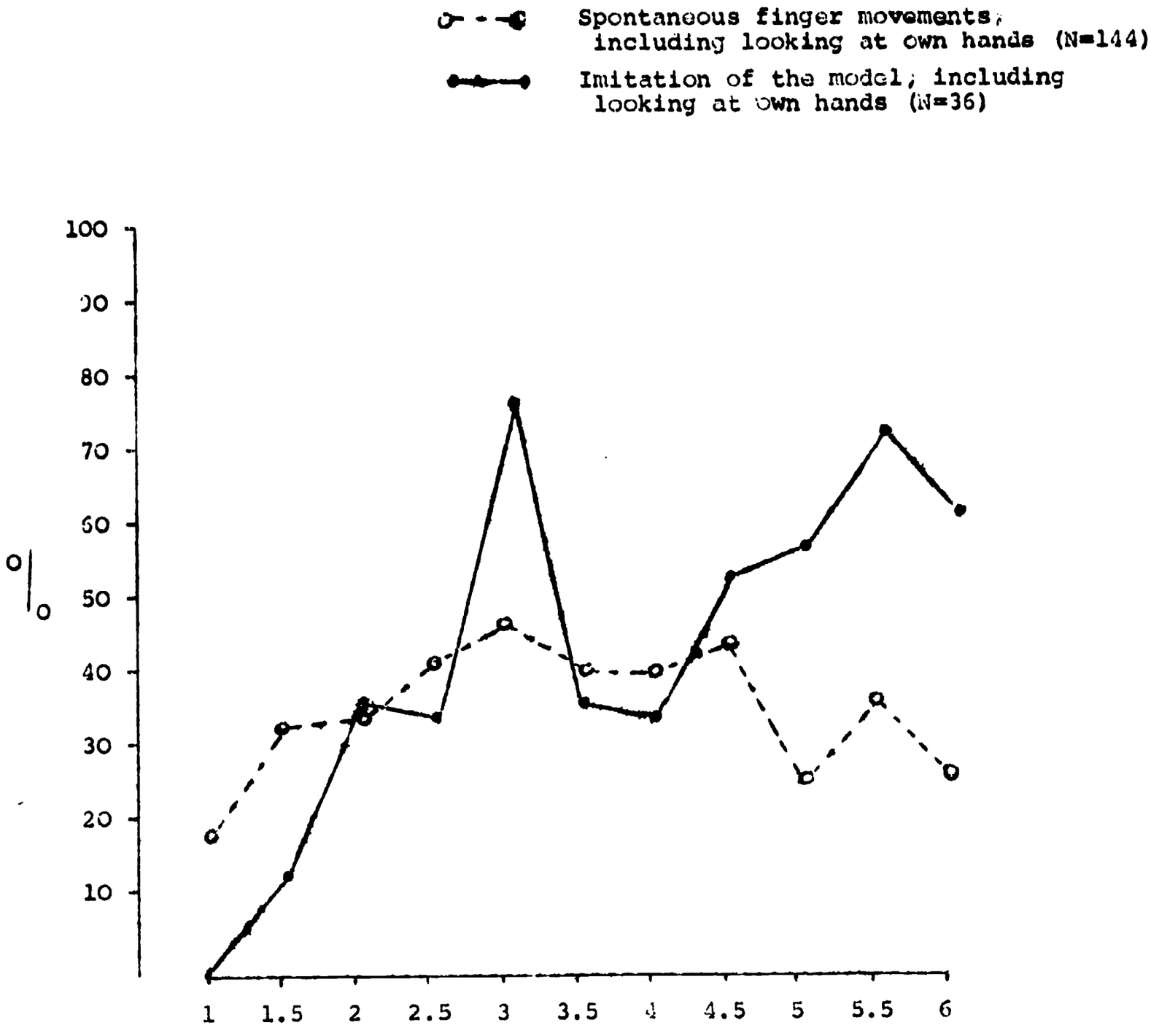

Figure 3

ONE ARM MOVEMENT MODEL (N=36)

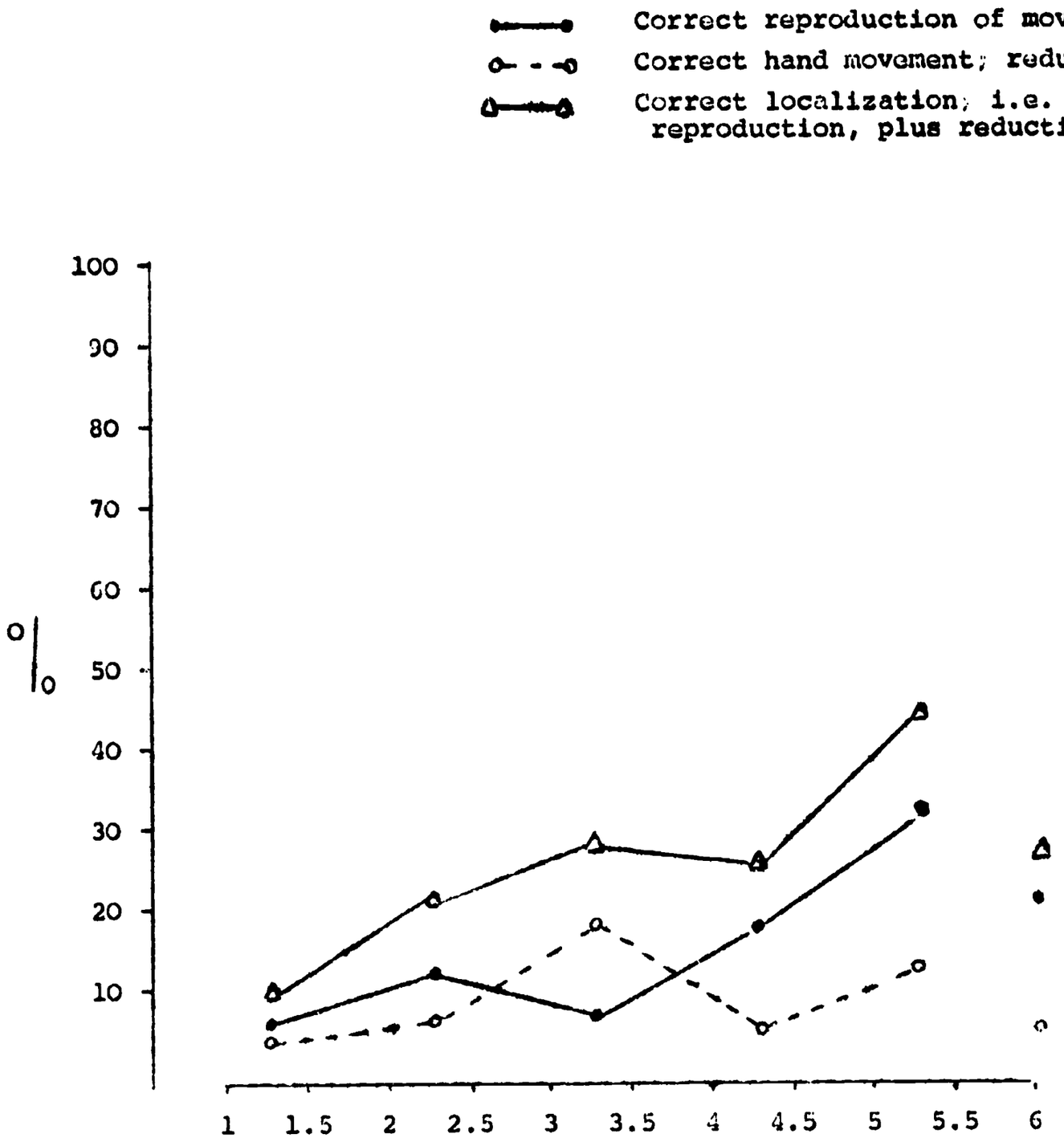

Figure 9

VOCALIZATIONS

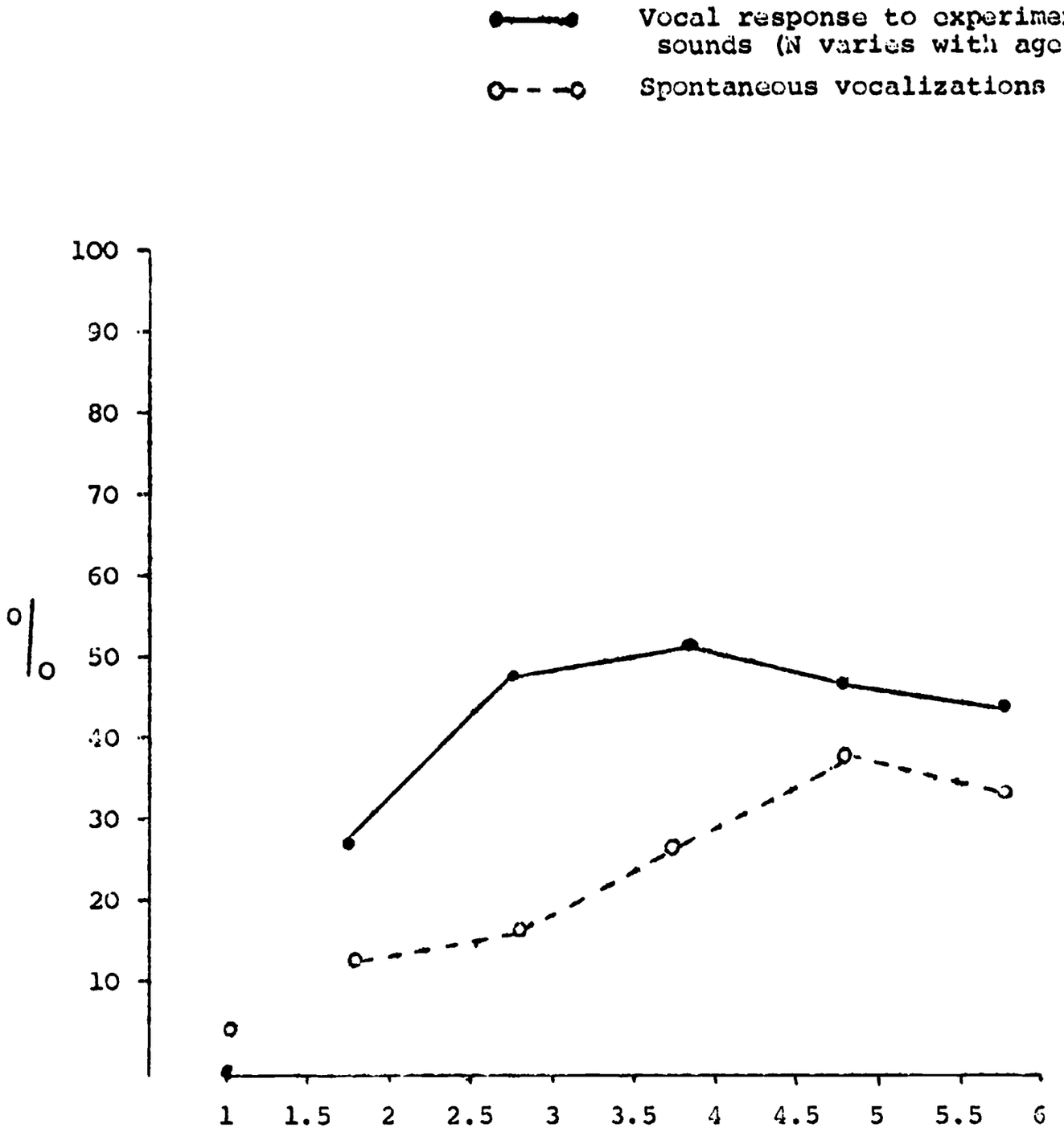

Figure 10

RECORDED BABBLING MODEL (N=36)

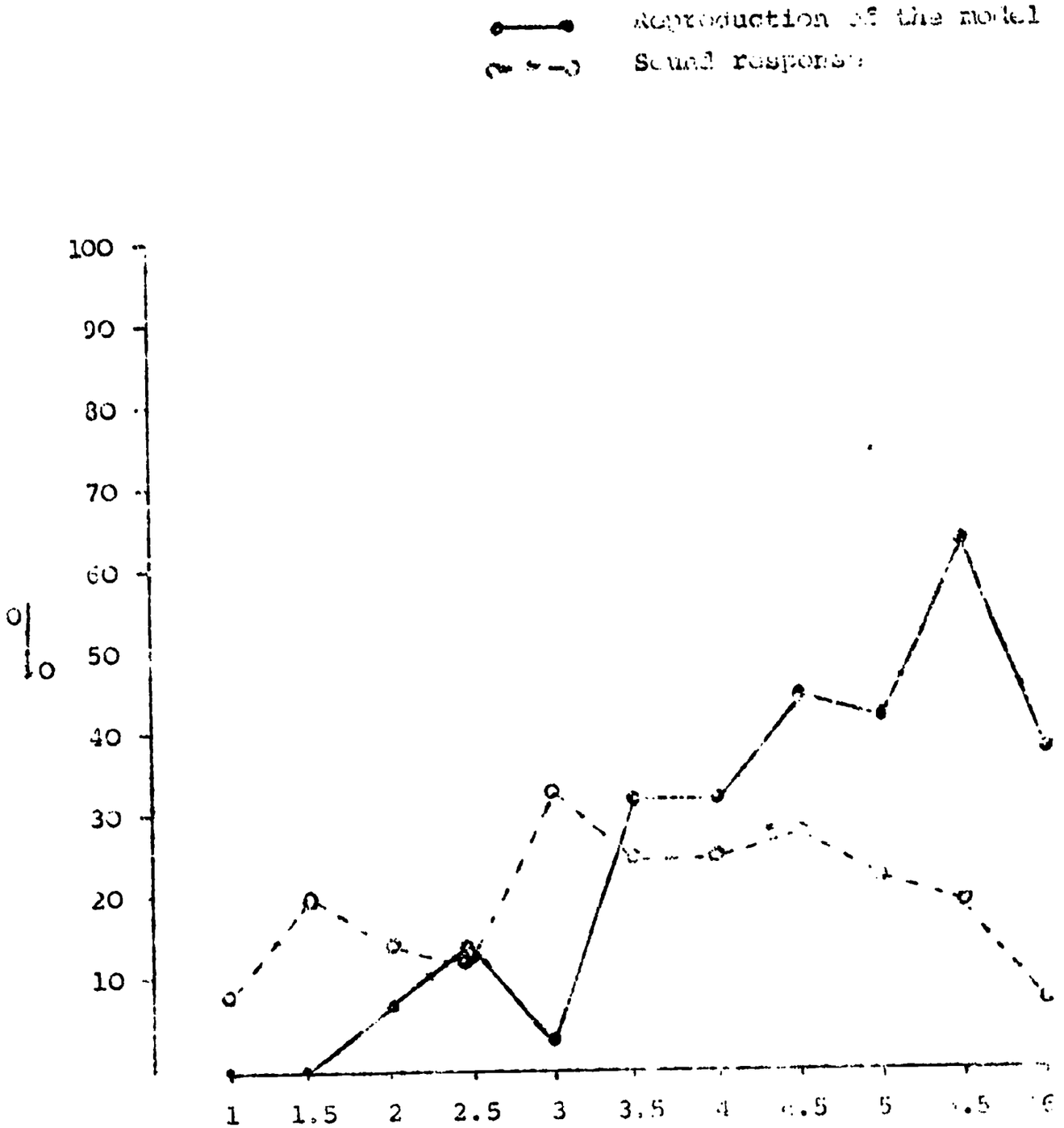

Figure 11

RECORDED CRYING MODEL (N=36)

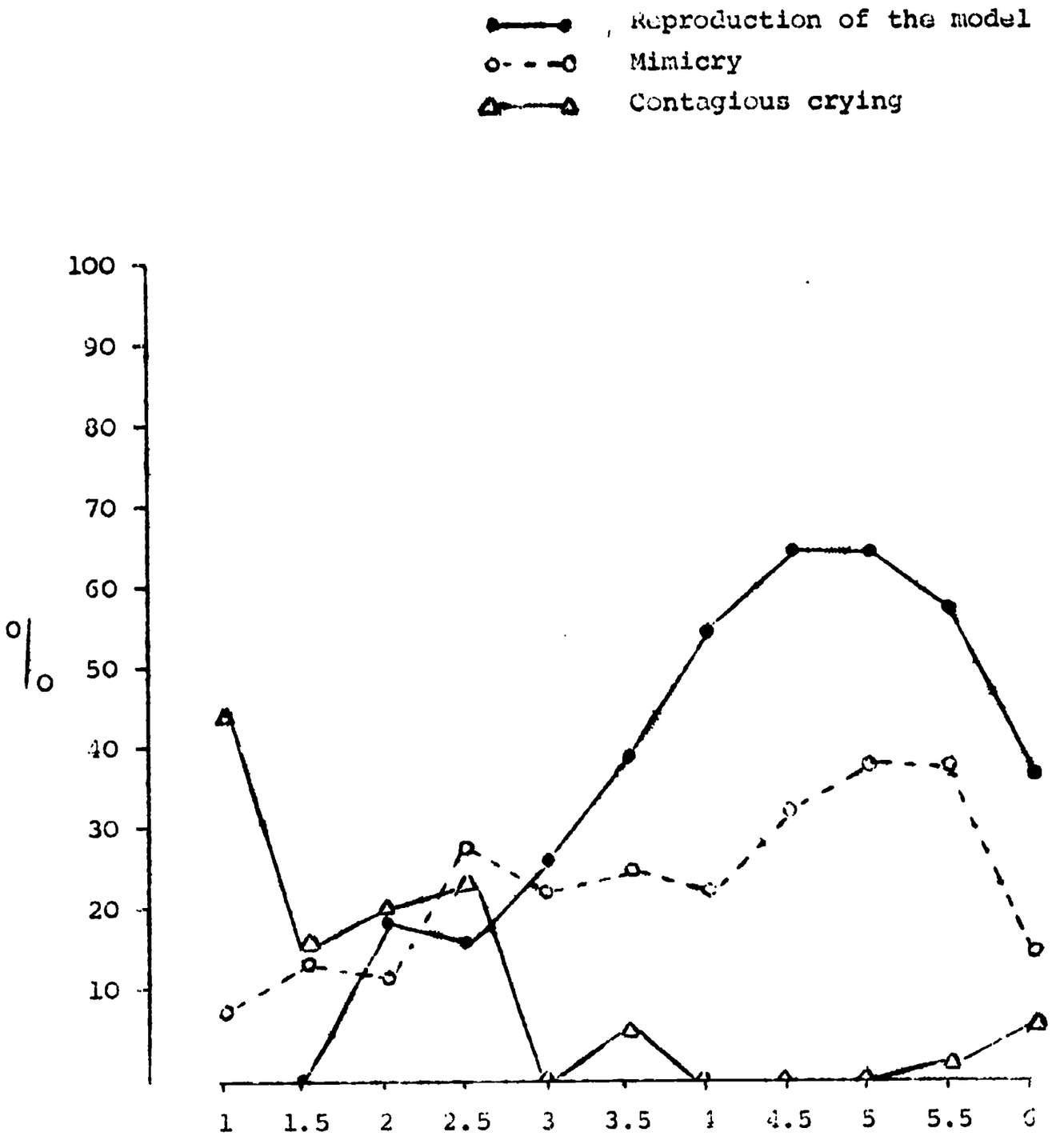

Figure 12